Ontario

Apprenticeship
In-school Curriculum Standards

Automotive Service Technician

Level 3

310S

Ministry of Training, Colleges and Universities

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AUTOMOTIVE SERVICE TECHINICIAN – LEVEL 3

TABLE OF CONTENTS

Introduction

LEVEL 3

Program Summary of Reportable Subjects 1

S1231 Work Practices 2
1.1 Diagnose and Repair Climate Control Systems 3
1.2 Body and Trim 6

S1232 Engines Systems 8
2.1 Engine Cooling Systems and Diagnostics 9
2.2 Accessory Drive Belts and Pulleys 11
2.3 Lubrication Systems 12
2.4 Engine Component Failure Analysis 14
2.5 Engine Replacement and Start-up Preparation 16

S1233 Electrical / Electronic and Emissions Systems 17
3.1 Computer Fundamentals 19
3.2 Supplemental Restraint Systems 20
3.3 Distributorless Ignition Systems 21
3.4 Computer Controlled Charging Systems 22
3.5 Power Accessories and Electrical Options 23
3.6 Gasoline Fuel Ignition Diagnosis and Repair 24
3.7 Diesel Electronic Fuel Injection Fundamentals 26
3.8 Emissions Control Diagnosis and Repair 27
3.9 Hybrid Systems 28

S1234 Drive Train Systems 29
3.10 Automatic Transmission / Transaxle Hydraulic Control Systems 30
3.11 Automatic Transmission / Transaxle Operations 31
3.12 Automatic Transmission / Transaxle Diagnosis and Service Procedures 32
3.13 Automatic Transmission / Transaxle Electronic Controls 34
3.14 Transfer Cases / 4 Wheel Drive / All Wheel Drive 36
3.15 Alternate Drive Lines / Hybrid Driveline 37

S1235 Suspension / Steering and Brake Systems 38
5.1 Power Assisted Brakes 40
5.2 Anti-Lock Brake Fundamentals 41
5.3 Anti-Lock Brake Diagnostics 43
5.4 Electronic Braking 44
5.5 Tire Pressure Monitoring Systems 45

5.6 Electronic Suspension Systems 46
5.7 Vehicle Pre-alignment Inspection 47
5.8 Vehicle Alignment Diagnostics 48
5.9 Vehicle Alignment 49

AUTOMOTIVE SERVICE TECHINICIAN – LEVEL 3

Introduction

This new curriculum standard for the Automotive Service Technician trade program is based upon the on-the-job performance objectives, located in the industry-approved training standard.

The curriculum is organized into 5 reportable subjects. The Program Summary of Reportable Subjects chart summarizes the training hours for each reportable subject.

The curriculum identifies only the learning that takes place off-the-job. The in-school program focuses primarily on the theoretical knowledge and the essential skills required supporting the performance objectives of the Apprenticeship Training Standards. Employers/Sponsors are expected to extend the apprentice's knowledge and skills through practical training on the work site. Regular evaluations of the apprentice's knowledge and skills are conducted throughout training to ensure that all apprentices have achieved the learning outcomes identified in the curriculum standard.

It is not the intent of the in-school curriculum to perfect on-the-job skills. The practical portion of the in-school program is used to reinforce theoretical knowledge. Skill training is provided on the job.

Automotive Service Technician

Level 3

AUTOMOTIVE SERVICE TECHNICIAN - LEVEL 3

Program Summary of Reportable Subjects - Level 3

Number	Reportable Subjects	Hours Total	Hours Theory	Hours Practical
1	Work Practices	30	16	14
2	Engine Systems	36	24	12
3	Electrical / Electronic And Emissions Systems	96	64	32
4	Drive Train Systems	36	24	12
5	Suspension / Steering And Brake Systems	42	26	16
	Total	240	154	86

AUTOMOTIVE SERVICE TECHINICIAN – LEVEL 3

Number: **S1231**

Reportable Subject: **WORK PRACTICES**

Duration: Total 30 hours Theory 16 hours Practical 14 hours

Prerequisites: Level II, Reportable1, 2, 3

1.1 Diagnose and Repair Climate Control Systems

Total 26 hours Theory 14 hours Practical 12 hours

1.2 Body and Trim

Total 4 hours Theory 2 hours Practical 2 hours

Evaluation Structure

The following evaluation structure is only a suggested format. Specific evaluation of the theory and practical components of training will vary due to the institutional evaluation protocol, available resource material, training aides utilized and learning level of the individual student(s).

Evaluation should be broken down into two distinct areas; Theory Testing and Practical Application Exercises. The percentage between these two areas is directly related to the percentage of time that has been assigned for each Reportable subject.

Theory Testing	Practical Application Testing
70 %	30 %

AUTOMOTIVE SERVICE TECHINICIAN – LEVEL 3

1.1 Diagnose and Repair Climate Control Systems

Duration: Total 26 hours Theory 14 hours Practical 12 hours

Cross Reference to Training Standards: 5172.01, 02, 03, 04

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to explain the operating principles, perform inspection, test and diagnose climate control system according to manufacturers' standards.

LEARNING OUTCOMES AND CONTENT

1.1.1 Explain the principles of compressor control systems.

- drivability controls
  - coolant temperature sensor
  - voltage load shedding
  - RPM
  - throttle position sensor
  - power steering pressure
- compressor protection
  - ambient temp sensor
  - low and high pressure cutout
  - compressor temperature sensor
  - compressor rpm sensor
  - superheat circuit
  - pressure relief valve
  - fan controls
  - electric and viscous drive
  - pressure and temperature
- evaporator temperature controls
  - thermostats and evaporator temperature sensors
  - pressure cycling
  - variable displacement compressors
- suction throttle, evaporator pressure regulator systems

1.1.2 Identify the components of compressor control systems.

- drivability controls
- compressor protection
- evaporator temperature controls
- STV, EPR systems

1.1.3 Explain the operating principles of automatic climate control systems.

- fully automatic, semi-automatic, manual control
  - airflow control
  - blower control
  - mode control
- control units
  - PCM
  - BCM
  - control head
  - programmer
- input sensors
  - ambient
  - in-car
  - coolant/heater core
  - sunload
  - driver
- outputs
  - blend door motor
  - temperature and coolant flow controls
  - mode door motors
  - blower control unit
  - vacuum circuits

1.1.4 Describe inspection and testing procedures for climate control systems.

- climate controls
  - visual inspection
  - retrieving data and trouble codes
  - determine faults without trouble codes
  - diagnose temperature and air flow
- refrigeration system
  - visual inspection of all AC components
  - diagnosis using gauges
- diagnose failed compressors and clutches
  - symptoms of hydraulic lock.
  - recognition of oil starvation
  - testing belt tensioners
  - check for low voltage
- leakage repairs
- flushing and filtering
- de-odorizing smells from air plenums

AUTOMOTIVE SERVICE TECHINICIAN – LEVEL 3

1.1.5 Perform inspection and testing procedures for climate control systems performance tests.

- climate controls
  - visual inspection
  - retrieving data and trouble codes
  - determine faults without trouble codes
  - diagnose temperature and air flow problems
  - movement and actuator performance
- refrigeration system
  - visual inspection
  - diagnosis using gauges
  - diagnosis of failed compressors and clutches
  - replace clutches on compressors
- repair lines and hoses
- leakage repairs by identifying leaky components
- flushing and filtering contaminated components
- de-odorizing smells from air plenums

AUTOMOTIVE SERVICE TECHINICIAN – LEVEL 3

1.2 Body and Trim

Duration: Total 4 hours Theory 2 hours Practical 2 hours

Cross Reference to Training Standards: 5173.01, 02, 03, 04

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to explain the purpose and construction of body trim and glass components and perform necessary repairs following manufacturers' recommendations.

LEARNING OUTCOMES AND CONTENT

1.2.1 Explain the purpose of body and trim components.

- weather stripping
- windows and regulators
- windshield/rear glass integrity
- headlamp aiming
- interior and exterior trim

1.2.2 Identify body and trim components.

- weather stripping
- windows and regulators
- windshield sealants
- headlamps
- interior and exterior trim

1.2.3 Describe inspection, testing and repair procedures to body and trim components.

- aim headlamp
- fit and leaks
  - water
  - dust
- noise location and repair
  - squeaks
  - rattles
  - wind

1.2.4 Perform inspection and testing procedures to body and trim components.

- aim headlamp
- check fits to control
  - water leaks
  - dust leaks
- check noise location and repair
  - squeaks
  - rattles
  - wind

AUTOMOTIVE SERVICE TECHINICIAN – LEVEL 3

Number: **S1232**

Reportable Subject: **ENGINE SYSTEMS**

Duration: Total 36 hours Theory 24 hours Practical 12 hours

Prerequisites: Level I, Reportable 2

2.1 Engine Cooling Systems and Diagnostics

Total 9 hours Theory 7 hours Practical 2 hours

2.2 Accessory Drive Belts and Pulleys

Total 3 hours Theory 1 hour Practical 2 hours

2.3 Lubrication Systems

Total 9 hours Theory 7 hours Practical 2 hours

2.4 Engine Component Failure Analysis

Total 12 hours Theory 8 hours Practical 4 hours

2.5 Engine Replacement and Start-up Preparation

Total 3 hour Theory 1 hour Practical 2 hours

Evaluation Structure

The following evaluation structure is only a suggested format. Specific evaluation of the theory and practical components of training will vary due to the institutional evaluation protocol, available resource material, training aides utilized and learning level of the individual student(s).

Evaluation should be broken down into two distinct areas; Theory Testing and Practical Application Exercises. The percentage between these two areas is directly related to the percentage of time that has been assigned for each Reportable subject.

Theory Testing	Practical Application Testing
70 %	30 %

AUTOMOTIVE SERVICE TECHINICIAN – LEVEL 3

2.1 Engine Cooling Systems and Diagnostics

Duration: Total 9 hours Theory 7 hours Practical 2 hours

Cross Reference to Training Standard: 5161.01, 02, 03, 04

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to explain the operating principles of cooling systems, perform maintenance, diagnose and service according to manufacturers' recommendations.

LEARNING OUTCOMES AND CONTENT

2.1.1 Define the fundamentals of engine cooling systems.

- fundamentals of coolant
  - convection, conduction and radiation
  - temperature effects
  - heat measurement
  - the effects of pressure on boiling points / ratio

2.1.2 Identify engine cooling system components.

- liquid-cooled systems
- full circulation
  - thermostat
  - radiators and heater cores
  - pressure caps
  - coolant pumps
- fans
  - electrical, viscous, mechanical
  - shrouds and deflectors
- oil coolers
- coolant level sensors

2.1.3 Explain the operation and effect of engine cooling systems.

- liquid cooled systems

2.1.4 Perform inspection and testing for an engines cooling system.

- visual inspection
- PH testing / quality of water
- pressure test liquid cooling system
- test coolant freeze protection, condition and compatibility
- test for both internal and external leakage
    - visual
    - fluorescent dye
    - pressure tester
    - temperature / leak relationship
    - cylinder leakage tester
    - combustion gas tester
- check for presence of transfer between systems
- test for system flow restrictions
- test engine temperature control operation

2.1.5 Research recommended cooling system service and maintenance procedures.

- external cooling system cleaning
- system flushing and anti-freeze replacement
- describe procedures for replacement of
    - thermostats
    - fan or fan drives or belts
    - radiators
    - water pump
    - heater cores
    - core plugs
    - flushing of oil coolers

2.2 Accessory Drive Belts and Pulleys

Duration: Total 3 hours Theory 1 hour Practical 2 hours

Cross-Reference to Training Standards: 5161.01, 02, 03, 04

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to explain the operating principles of belt and pulley systems, perform maintenance, diagnose and service according the manufacturers' recommendation.

LEARNING OUTCOMES AND CONTENT

2.2.1 Identify the types and applications of belt and pulley systems.

- double edged serpentine and V-belts
- pulleys
- manual adjusters
- idlers / tensioners
- routing diagrams
- ratios

2.2.2 Perform recommended inspection and service procedures for belts and pulleys.

- identification
- dimensions
- cracks
- wear
- deterioration
- alignment
- tension
- temperature
- pulley wear
- bearings
  - remove, replace and adjust
  - belts
  - pulleys
  - idlers

2.2.3 Diagnose and repair belt and pulley systems.

- check for vibration
- check for noise
- verify system condition

AUTOMOTIVE SERVICE TECHINICIAN – LEVEL 3

2.3 Lubrication Systems

Duration: Total 9 hours Theory 7 hours Practical 2 hours

Cross-Reference to Training Standards: 5161.01, 05, 06, 07

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to explain the operating principles of lubrication systems, perform maintenance, diagnose and service according to manufacturers' recommendations.

LEARNING OUTCOMES AND CONTENT

2.3.1 Define the fundamentals of engine lubrication systems.

- friction
- hydrodynamic lubrication
- engine lubrication components
- oil characteristics, properties, additives and classification
- lubrication system cooling

2.3.2 Describe the characteristics and application of engine lubrication system components.

- types oil pumps
- oil coolers and heat exchangers
- oil filters and protection valve
- oil pressure sending unit and pressure relief valve

2.3.3 Explain the operating principles of engine lubrication systems.

- oil pumps
- oil filtering methods and characteristics
- engine oils
- heat exchangers
- protection and pressure relief devices
- oil life monitoring

2.3.4 Perform recommended inspection, testing and service procedures on lubrication systems.

- visual inspection for oil leaks
  - engine running
  - engine off
- perform engine oil pressure test
- inspect engine oil condition and level
- perform oil life monitor reset
- identify the sources and detrimental effects of engine oil contamination
  - worn bearings
  - leaking gaskets and seals
  - auxiliary cooler defects
  - filters
  - fuel dilution
  - engine temperatures
  - oxidation
  - sludge
  - chemical reaction of oil and contaminants
  - oil additives
  - engine oil sampling
- describe engine oil and filter replacement procedures
- identify the significance of
  - selecting the correct engine oil
  - priming oil pumps and filters
  - oil and filter change intervals for all driving conditions

2.3.5 Research manufacturers' recommendations for lubrication system service and maintenance.

- prepare summary of oil pump overhaul and replacement procedures
- oil pressure sending units and regulators
- cleaning procedures

2.4 Engine Component Failure Analysis

Duration: Total 12 hours Theory 8 hours Practical 4 hours

Cross-Reference to Training Standards: 5161.01, 02, 05, 08, 11

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to explain and perform the recommended engine diagnostic and testing procedures following manufacturers' recommendations.

LEARNING OUTCOMES AND CONTENT

2.4.1 Explain the fundamentals of engine component failure analysis and diagnosis.

- define diagnosis as applied to internal combustion engine failures
- identify diagnostic procedures for primary and secondary causes of component failure
- explain diagnostic procedures for:
  - lubricating systems
  - cooling systems
  - power loss
  - oil consumption
  - engine-related noises
  - vibrations
  - mechanical failure
  - normal wear

2.4.2 Perform recommended inspection and testing procedures to determine causes of engine failures.

- perform engine component assessment for failure analysis on:
  - valve timing mechanism
  - effect of wear on gears, chains and belts
  - valve timing
  - valve lash
  - balance shafts
  - camshafts
  - blocks and crankshafts
  - cylinders, pistons and rings
  - connecting rods and pins
  - bearings and seals
  - mechanical failure
  - normal wear

2.4.3 Explain the principles of operation of engine testing and diagnostic equipment.

- vacuum testers
- compression
- cylinder leakage

2.4.4 Perform assigned operations using vacuum, compression and cylinder leakage equipment.

- vacuum testing
- compression testing
- cylinder leakage
- valve adjustment
- identify and verify valve marks and correct valve timing

AUTOMOTIVE SERVICE TECHINICIAN – LEVEL 3

2.5 Engine Replacement and Start-up Preparation

Duration: Total 3 hours Theory 1 hour Practical 2 hours

Cross-Reference to Training Standards: 5161.01, 5163.11

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to explain recommended replacement and start-up procedures according manufacturers' recommendation and trade practices.

LEARNING OUTCOMES AND CONTENT

2.5.1 Research manufacturers' recommendations for engine removal and installation.

- sequence
- lifting techniques
- storing and supporting components
- explain the procedures to remove and replace an engine
- draining of fluids and recovery of refrigerants
- replacement precautions

2.5.2 Describe the principles and procedures used in the initial start-up of an overhauled engine assembly.

- oil circuit priming
- oil levels
- basic timing adjustments
- supercharger and turbocharger precautions

AUTOMOTIVE SERVICE TECHINICIAN – LEVEL 3

Number: **S1233**

Reportable Subject: **ELECTRICAL / ELECTRONICS AND EMISSIONS**

Duration: 96 Total hours Theory 64 hours Practical 32 hours

Prerequisites: Level II, Reportable 1, 2, 3, 4, 5

3.1 Computer Fundamentals

Total 6 hours Theory 4 hours Practical 2 hours

3.2 Supplemental Restraint Systems

Total 8 hours Theory 6 hours Practical 2 hours

3.3 Distributorless Ignition Systems

Total 8 hours Theory 4 hours Practical 4 hours

3.4 Computer Controlled Charging Systems

Total 8 hours Theory 4 hours Practical 4 hours

3.5 Power Accessories and Electrical Options

Total 18 hours Theory 12 hours Practical 6 hours

3.6 Gasoline Fuel Ignition Diagnosis and Repair

Total 16 hours Theory 10 hours Practical 6 hours

3.7 Diesel Electronic Fuel Injection Fundamentals

Total 8 hours Theory 6 hours Practical 2 hours

3.8 Emissions Control Diagnosis and Repair

Total 20 hours Theory 14 hours Practical 6 hours

3.9 Hybrid Systems

Total 4 hours Theory 4 hours Practical 0 hours

Evaluation Structure

The following evaluation structure is only a suggested format. Specific evaluation of the theory and practical components of training will vary due to the institutional evaluation protocol, available resource material, training aides utilized and learning level of the individual student(s).

Evaluation should be broken down into two distinct areas; Theory Testing and Practical Application Exercises. The percentage between these two areas is directly related to the percentage of time that has been assigned for each Reportable subject.

Theory Testing	Practical Application Testing
70 %	30 %

AUTOMOTIVE SERVICE TECHINICIAN – LEVEL 3

3.1 Computer Fundamentals

Duration: Total 6 hours Theory 4 hours Practical 2 hours

Cross Reference to Training Standards: 5163.01, 08, 09, 10, 5164.01, 02, 03

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to explain the principles of operations of vehicle on board computers according to manufacturers' specifications.

LEARNING OUTCOMES AND CONTENT

3.1.1 Explain the principles of operation of vehicle on board computers.

- onboard computers
- multiplexing
- fibre optics
- data bus communication lines
- CAN bus
- central processing unit (CPU)
- random access memory (RAM)
- read only memory (ROM)

3.1.2 Perform data retrieval with appropriate test equipment.

- oscilloscope
- scan tool
- flight recorder

AUTOMOTIVE SERVICE TECHINICIAN – LEVEL 3

3.2 Supplemental Restraint Systems

Duration: Total 8 hours Theory 6 hours Practical 2 hours

Cross Reference to Training Standards: 5164.01, 05, 06, 07

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to explain the fundamentals, construction, principles of operation, inspection, and testing procedures of supplemental restraint systems according to manufacturers' standards.

LEARNING OUTCOMES AND CONTENT

3.2.1 Explain the purpose, construction, types, applications and fundamentals of supplemental restraint systems.

- deceleration forces
- inflatable supplemental restraint systems
- pretension seat belts
- crash sensors
- control modules
- air bags
- air bags inflators
- clock spring
- seat occupancy sensors
- passenger-side airbag disabling system
- explain safe handling precautions for service and testing of inflatable and non-inflatable restraint systems

3.2.2 Inspect, test and explain safe handling procedures for restraint system components.

- safely disable restraint systems
- perform system tests using scan tools, multimeter and specific test equipment

3.3 Distributorless Ignition Systems

Duration: Total 8 hours Theory 4 hours Practical 4 hours

Cross Reference to Training Standards: 5163.01, 05, 06

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to explain the principles of operation, construction, types, inspection, and testing procedures for distributorless ignition systems according to manufacturers' standards.

LEARNING OUTCOMES AND CONTENT

3.3.1 Explain the purpose, construction, types, applications and fundamentals of distributorless ignition systems.

- coils
- coil over plug
- modules
- sensors
  - crankshaft position
  - camshaft position

3.3.2 Inspect and test distributorless ignition systems.

- identify and locate ignition system components
  - coils
  - modules
  - sensors
  - wiring and connections
- test for correct operation of distributorless ignition systems

3.4 Computer Controlled Charging Systems

Duration: Total 8 hours Theory 4 hours Practical 4 hours

Cross Reference to Training Standards: 5162.01, 07, 08, 09

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to explain the principles of operation, construction, types, inspection, and testing procedures for computer-controlled charging systems according to manufacturers' standards.

LEARNING OUTCOMES AND CONTENT

3.4.1 Explain the purpose, construction, types, applications and fundamentals of computer-controlled charging systems and electronic regulators.

- computer-controlled charging system
  - alternator field current control
  - ambient temperature sensing
  - battery voltage sensing
  - battery temperature sensing
- voltage regulator operation
  - location
  - alternator output monitoring
- charging system indicators

3.4.2 Inspect and test computer-controlled charging systems.

- test computer-controlled charging systems
- identify and isolate faulty charging system components

AUTOMOTIVE SERVICE TECHINICIAN – LEVEL 3

3.5 Power Accessories and Electrical Options

Duration: Total 18 hours Theory 12 hours Practical 6 hours

Cross Reference to Training Standards: 5164.01, 02, 03, 04

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to explain the principles of operation, inspection, and testing procedures of electrical accessories according to manufacturers' standards.

LEARNING OUTCOMES AND CONTENT

3.5.1 Explain the fundamentals, types, principles of operation of electrical accessories.

- lighting system
  - daytime running lights
  - automatic operation
  - light emitting diode
  - high intensity discharge
- power accessories
  - power windows
  - power door locks
  - wiper washer systems
- power seats
- inverters
- security systems
- remote entry and remote starting systems
- instrumentation
- cruise control systems
- communication and entertainment systems

3.5.4 Inspect, test and diagnose electrical accessories.

- diagnose faults, i.e., shorts, opens, grounds, high resistance
- analysis circuit with wiring diagrams and troubleshooting charts
- perform safety precautions when dealing with electronic devices

AUTOMOTIVE SERVICE TECHINICIAN – LEVEL 3

3.6 Gasoline Fuel Injection Diagnosis and Repair

Duration: Total 16 hours Theory 10 hours Practical 6 hours

Cross Reference to Training Standards: 5163.01, 02, 03, 04, 5165.01, 02, 03, 04

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to explain principles of operation, construction, inspection, and testing procedures for gasoline fuel injection systems according to manufacturers' standards.

LEARNING OUTCOMES AND CONTENT

3.6.1 Explain the construction, types, and principles of operation of fuel injection systems and components.

- input sensors
  - temperature sensors
  - manifold absolute pressure sensors
  - air flow sensors
  - oxygen sensors
  - throttle position sensors
  - throttle-pedal position sensors
  - crank & cam position sensors
  - switch inputs
- electronic control module
  - powers & grounds
  - data communication lines
  - diagnostics
- output actuators
  - malfunction indicator light
  - fuel injectors
  - idle speed control
  - exhaust gas recirculation
  - electronic throttle actuator
  - evaporative emission controls
  - cooling fans
  - spark control
  - air pumps
  - solenoids
  - relays
  - modules

3.6.2 Identify, inspect and test electronic fuel injection systems.

- input sensors
  - temperature sensors
  - manifold absolute pressure sensors
  - air flow sensors
  - oxygen sensors
  - throttle position sensors
  - throttle-pedal position sensors
  - crank & cam position sensors
  - switch inputs
- electronic control module
  - powers & grounds
  - data communication lines
  - diagnostics
    - data stream
    - diagnostic trouble codes
    - freeze frame data
- output actuators
  - malfunction indicator light
  - fuel injectors
  - idle speed control
  - exhaust gas recirculation
  - electronic throttle actuator
  - evaporative emission controls
  - cooling fans
  - spark control
  - air pumps
  - solenoids
  - relays
  - modules
- perform an injector balance test
- diagnose fault(s)
  - retrieve trouble code
  - access diagnostic information
  - diagnose
  - repair & verify

AUTOMOTIVE SERVICE TECHINICIAN – LEVEL 3

3.7 Diesel Electronic Fuel Injection Fundamentals

Duration: Total 8 hours Theory 6 hours Practical 2 hours

Cross Reference to Training Standards: 5165.01, 05, 06, 07

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to explain the purpose, construction, principles of operation, inspection and testing for diesel fuel systems according to manufacturers' standards.

LEARNING OUTCOMES AND CONTENT

3.7.1 Explain the purpose and fundamentals of diesel fuel injection systems.

- fundamentals of diesel fuel
- principles of compression ignition
- principles of fuel metering

3.7.2 Explain the construction, types, application and principles of operation of diesel fuel injection components.

- transfer pumps
- common rail fuel systems
- tanks, lines, filters, hoses and fittings
- water separators / fuel heater
- mechanical injectors
- injection inline pumps
- injection distributor pumps
- glow plugs systems
- emission controls
- bio diesel

3.7.3 Explain inspection and testing procedures.

- visual inspection of lines, filters, fuel delivery pumps and water separators
- interpret data for electronic management systems
- common rail fuel systems
- demonstration of fuel delivery pump test
- capacity, pressure, vacuum, return flow
- demonstrate fuel injector testing adhering to required safety procedures
- pressure (pop) opening, spray pattern, leakage, leak-back, chatter
- describe low and high-pressure fuel priming procedures and fuel filters
- describe the replacement procedures for fuel filters

AUTOMOTIVE SERVICE TECHINICIAN – LEVEL 3

3.8 Emissions Control Diagnosis and Repair

Duration: Total 20 hours Theory 14 hours Practical 6 hours

Cross Reference to Training Standards: 5174.01, 08, 09, 10, 11, 12, 13

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to explain inspection and testing of emission control systems to On Board Diagnostics II (ODB II) standards.

LEARNING OUTCOMES AND CONTENT

3.8.1 Explain the government standards and regulations for exhaust emissions and different methods used for annual emissions inspections.

- IM240
- RG240
- ASM
  - carbon monoxide
  - carbon dioxide
  - hydrocarbons
  - oxides of nitrogen
  - oxygen

3.8.2 Explain the effects of component malfunctions on exhaust emissions.

- exhaust gas recirculation
- evaporative emission systems
- catalytic convertor
- positive crankcase ventilation
- air injection systems
- ignition system

3.8.3 Inspect, test and analyze emission control devices using scan tools, gas analyzers, oscilloscopes, smoke generator and temperature probes.

- exhaust gas recirculation valves
- air injection pump
- catalytic converters
- spark timing control devices
- oxygen sensors
- evaporative emission controls

3.9 Hybrid Systems

Duration: Total 4 hours Theory 4 hours Practical 0 hours

Cross Reference to Training Standards: OA H-19.01

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to explain the principles of operation and diagnosis of fuel, electrical drive and regenerative braking systems associated with hybrid vehicles according to manufacturers' standards.

LEARNING OUTCOMES AND CONTENT

3.9.1 Explain code extraction, diagnostic routines, diagnosis and testing procedures associated with hybrid fuel and electrical system types.

- hybrid system types
  - Toyota - Synergy system
  - Honda - Integrated Motor Assist (IMA)
  - General Motors / Saturn - Belt Alternator Starter (BAS)
  - General Motors / Chrysler / BMW - Dual Mode
- high voltage disconnect
- meter use
- high and intermediate voltage drive systems
- start up
- idle stop
- inverter
- transmission pump operation
- vacuum pump operation

AUTOMOTIVE SERVICE TECHINICIAN – LEVEL 3

Number: **S1234**

Reportable Subject: Drive Train Systems

Duration: Total 36 hours Theory 24 hours Practical 12 hours

Prerequisites: Level 2, Reportable 2, 3, 4

4.1 Automatic Transmission / Transaxle Hydraulic Control Systems

Total 3 hours Theory 3 hours Practical 0 hours

4.2 Automatic Transmission / Transaxle Operations

Total 6 hours Theory 6 hours Practical 0 hours

4.3 Automatic Transmission / Transaxle Diagnosis and Service Procedures

Total 12 hours Theory 4 hours Practical 8 hours

4.4 Automatic Transmission / Transaxle Electronic Controls

Total 7 hours Theory 4 hours Practical 3 hours

4.5 Transfer Cases / 4 Wheel Drive / All Wheel Drive

Total 5 hours Theory 4 hours Practical 1 hour

4.6 Alternate Drive Lines / Hybrid Driveline

Total 3 hours Theory 3 hours Practical 0 hour

Evaluation Structure

The following evaluation structure is only a suggested format. Specific evaluation of the theory and practical components of training will vary due to the institutional evaluation protocol, available resource material, training aides utilized and learning level of the individual student(s).

Evaluation should be broken down into two distinct areas; Theory Testing and Practical Application Exercises. The percentage between these two areas is directly related to the percentage of time that has been assigned for each Reportable subject.

Theory Testing	Practical Application Testing
70 %	30 %

AUTOMOTIVE SERVICE TECHINICIAN – LEVEL 3

4.1 Automatic Transmission / Transaxle Hydraulic Control Systems

Duration: Total 3 hours Theory 3 hours Practical 0 hours

Cross Reference to Training Standard: 5166.01, 08, 09, 10

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to perform visual inspection, diagnosis, troubleshoot, and repair automatic transmission / transaxle hydraulic systems according to manufacturers' standards.

LEARNING OUTCOMES AND CONTENT

4.1.1 Identify the specific components and describe the detailed operation of automatic transmission / transaxle hydraulics.

- pumps
- control system / valve body
  - mainline or control pressure regulator
  - manual, throttle, governor, shift, and modulator valves
  - converter control valves
  - limit valves
  - flow control
  - detent valves
  - hydraulic, mechanical, electrical and electronic control
  - hydraulic circuits and schematics

4.1.2 Perform inspection, testing, and diagnosis procedures on automatic transmissions / transaxle hydraulics.

- test hydraulic system pressure
- perform pump service
  - visual inspection
  - measurements
  - clearance checks
- inspect and service valve body
- perform failure analysis

4.2 Automatic Transmission / Transaxle Operations

Duration: Total 6 hours Theory 6 hours Practical 0 hours

Cross Reference to Training Standard: 5166.01, 08, 09, 10

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to explain the detailed operation of automatic transmissions / transaxles according to manufacturers' standards.

LEARNING OUTCOMES AND CONTENT

4.2.1 Explain the detailed operation of automatic transmission / transaxle applied and mechanical devices

- applied hydraulic circuits and schematics
  - driving and holding devices
    - bands
    - servos and pistons
    - clutches
    - one-way clutches
- gear train power flow
  - Simpson
  - Ravigneaux
  - Tandem compound

4.3 Automatic Transmission / Transaxle Diagnosis and Service Procedures

Duration: Total 12 hours Theory 4 hours Practical 8 hours

Cross Reference to Training Standard: 5166.01, 08, 09, 10

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to perform visual inspection, diagnosis, troubleshoot, and repair automatic transmission / transaxles following manufacturers' recommendations.

LEARNING OUTCOMES AND CONTENT

4.3.1 Perform inspection, testing, and diagnosis procedures on automatic transmissions / transaxles.

- visual inspection
- evaluate fluid level and condition
- interpret road test results
- access on board diagnostics and analyze data
- access applicable service information / technical service bulletins
- adjust linkage
- interpret hydraulic pressure test results
- power flow analysis
- shift evaluation
- symptom based diagnosis of transmission / component failures
- identify specific component failure and causes

4.3.2 Perform and explain service and repair procedures.

- determine disassembly sequence
- note cautions
- air test
- identify and locate special tools
- perform required measurements
- identify and determine manufacturers specific corrections
  - selective washers
  - clutch components

4.3.2 Continued

- disassemble transmission / transaxle
- identify components
- trace power flow through unit
- disassemble and inspect sub components
- perform failure analysis
- re-assemble and verify correct function
- change automatic transmission fluid and filters
- perform flushing of assemblies
- identify cautions to be observed during removal and replacement

AUTOMOTIVE SERVICE TECHINICIAN – LEVEL 3

4.4 Automatic Transmission / Transaxle Electronic Controls

Duration: Total 7 hours Theory 4 hours Practical 3 hours

Cross Reference to Training Standard: 5166.11, 12, 13

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to perform preliminary checks, diagnosis, troubleshoot, and repair automatic transmission / transaxles electronic controls according to manufacturers' recommendations.

LEARNING OUTCOMES AND CONTENT

4.4.1 Identify and describe specific applications of automatic transmission / transaxle electronic controls.

- power train control units (PCU)
- input devices (sensors) speed, position, pressure, temperature
- output devices (solenoids, relays) pressure, shift, torque converter clutch controls (TCC)
- data lines / communications
- on board diagnostics
  - scan tool utilization
  - code access
- effects on performance characteristics
  - shift timing
  - shift feel
  - torque
  - fuel economy
- integrated vehicle control systems
  - engine control module
  - body control module
  - suspension / traction control / electronic brake control module

4.4.2 Perform and interpret results of functional and diagnostic tests on automatic transmission / transaxle electronic controls

- component testing
  - input devices
  - output devices

4.4.2 Continued

- scan tool utilization
  - data lines / communications
  - on board diagnostics
  - code access
  - shift adaptives
- perform performance testing
- test pressure controls
- test shift controls
- test TCC control
- test integrated vehicle control systems
  - engine control module
  - body control module
  - suspension / traction control / electronic brake control module

4.5 Transfer Cases / 4 Wheel Drive / All Wheel Drive

Duration: Total 5 hours Theory 4 hours Practical 1 hour

Cross Reference to Training Standard: 5167.01, 02, 03, 04

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to perform visual inspection, diagnosis, troubleshoot, repair 4 wheel drive and all wheel drive systems according to manufacturers' recommendations.

LEARNING OUTCOMES AND CONTENT

4.5.1 Explain the fundamentals of 4 wheel drive and all wheel drive systems.

- function, types, styles and applications
  - 4 wheel drive
  - part time
  - full time

4.5.2 Describe the operation of 4 wheel and all-wheel drive systems.

- 4 wheel drive components and variations
- all-wheel drive components and variations
- automatic / manual locking hubs
- axle disconnects
  - electric / vacuum actuators
- viscous drive
- rear drive modules (RDM)
- controls and indicators
- electronic sensors

4.5.3 Perform inspection, testing, and diagnostic procedures on 4 wheel drive and all wheel drive systems.

- inspect wheel circumference
- identify operating ranges
- describe the removal and installation procedures
- perform measurements and adjustments
- identify component failures and causes

AUTOMOTIVE SERVICE TECHINICIAN – LEVEL 3

4.6 Alternate Drive Trains / Hybrid Driveline

Duration: Total 3 hours Theory 3 hours Practical 0 hours

Cross Reference to Training Standard: OA H-19.01

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to identify and define the basic operation of Hybrid / Alternate Drive Trains according to manufacturers' standards.

LEARNING OUTCOMES AND CONTENT

4.6.1 Identify and define hybrid / alternate drive trains applications.

- CVT / continuously variable transmission
- Sentronic / manual transmission automatically controlled (manumatic)
- Hybrid Drive Trains
  - CVT
  - Transmission / transaxle
  - BAS / belt alternator starter
  - IMA / integrated motor assist
  - ISAD / integrated starter alternator dampner
  - 2 Mode
  - Motor / Generator (MG1, MG2)
- Auxiliary Drive Trains
- Electric Drive Trains

4.6.2 Servicing Hybrid Vehicles.

- identify safety precautions
  - manufacturers safety procedures
  - high voltage
  - protective equipment
  - battery disconnect procedures

AUTOMOTIVE SERVICE TECHINICIAN – LEVEL 3

Number: **S1235**

Reportable Subject: **SUSPENSION / STEERING SYSTEMS AND BRAKES**

Duration: Total 42 hours Theory 26 hours Practical 16 hours

Prerequisites: Level II, Reportable 2, 3, 4, 5

5.1 Power Assisted Brakes

Total 6 hours Theory 4 hours Practical 2 hours

5.2 Anti-Lock Brake Fundamentals

Total 10 hours Theory 10 hours Practical 0 hours

5.3 Anti-Lock Brake Diagnostics

Total 6 hours Theory 0 hours Practical 6 hours

5.4 Electronic Braking

Total 2 hours Theory 2 hours Practical 0 hours

5.5 Tire Pressure Monitoring Systems

Total 1 hour Theory 1 hour Practical 0 hours

5.6 Electronic Suspension Systems

Total 2 hours Theory 2 hours Practical 0 hours

5.7 Vehicle Pre-alignment Inspection

Total 3 hours Theory 1 hour Practical 2 hours

5.8 Vehicle Alignment Diagnostics

Total 6 hours Theory 6 hours Practical 0 hours

5.9 Vehicle Alignment

Total 6 hours Theory 0 hours Practical 6 hours

AUTOMOTIVE SERVICE TECHINICIAN – LEVEL 3

Evaluation Structure

The following evaluation structure is only a suggested format. Specific evaluation of the theory and practical components of training will vary due to the institutional evaluation protocol, available resource material, training aides utilized and learning level of the individual student(s).

Evaluation should be broken down into two distinct areas; Theory Testing and Practical Application Exercises. The percentage between these two areas is directly related to the percentage of time that has been assigned for each Reportable subject.

Theory Testing	Practical Application Testing
70 %	30 %

AUTOMOTIVE SERVICE TECHINICIAN – LEVEL 3

5.1 Power Assisted Brakes

Duration: Total 6 hours Theory 4 hours Practical 2 hours

Cross Reference to Training Standard: 5170.01, 02, 03, 04

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to describe and explain the construction and operation of power assisted brakes; including inspection, testing and diagnostic procedures in accordance with manufacturers' recommendations.

LEARNING OUTCOMES AND CONTENT

5.1.1 Describe the construction and types of power assisted brake systems.

- vacuum assist
- hydraulic assist
- electric / hydraulic

5.1.2 Explain the operation of power assisted brake systems.

- vacuum assist
- hydraulic assist
- electric / hydraulic

5.1.3 Inspect, test and diagnose power assisted brakes.

- visual inspection
  - leaks
  - fluid levels
- operational and static test
- test vacuum assist
- test hydraulic assist
- test electric / hydraulic
- diagnosis
  - vacuum assist
  - hydraulic assist
  - electric / hydraulic

5.2 Anti-Lock Brake Fundamentals

Duration: Total 10 hours Theory 10 hours Practical 0 hours

Cross Reference to Training Standard: 5170.01

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to inspect, test and diagnose anti lock, stability and traction control systems including performing bleeding of the hydraulic system in accordance with manufactures' recommendations.

LEARNING OUTCOMES AND CONTENT

5.2.1 Define the fundamentals of anti-lock brake, traction and stability control systems.

- hydraulic pressure modulation
- electronic controls
- performance / advantages

5.2.2 Identify and explain the construction, types, and application of anti-lock brake systems, stability and traction control systems and components.

- integrated / non-integrated designs
- electric pumps
- accumulators
- sensors
- acceleration / yaw / pitch / roll sensors
- valve body assembly
- electronic controller
- one-channel
- two-channel
- three-channel
- four-channel

5.2.3 Explain the principles of operation of anti-lock, stability and traction control systems.

- safety procedures
- integrated / non-integrated designs
- electric pumps
- accumulators

5.2.3 Continued

- sensors
- acceleration / yaw / pitch / roll sensors
- valve body assembly
- electronic controller
- one-channel
- two-channel
- three-channel
- four-channel
- malfunction indicator lamps
- ABS action during apply, hold and release
- effects of tires

AUTOMOTIVE SERVICE TECHINICIAN – LEVEL 3

5.3 Anti-Lock Brake Diagnostics

Duration: Total 6 hours Theory 0 hours Practical 6 hours

Cross Reference to Training Standard: 5170.01, 05, 06, 07

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to inspect, test, diagnose anti lock, stability and traction control systems including performing bleeding of the hydraulic system in accordance with manufactures' recommendations.

LEARNING OUTCOMES AND CONTENT

5.3.1 Inspect, test and diagnose anti-lock, stability and traction control systems.

- visual inspection
  - leaks
  - fluid levels
- test system pressures
- test accumulator operation
- test control and sensor operation
- extract and analyze data
- retrieve fault codes
- retrieve live data

5.3.2 Perform assigned operations on anti-lock brake, stability and traction control systems.

- bleed the air from the hydraulic systems
  - manual procedure
  - electronic service tool procedure

5.4 Electronic Braking

Duration: Total 2 hours Theory 2 hours Practical 0 hours

Cross Reference to Training Standard: 5170.01, 08, 09, 10

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to explain the operation and components of electronic braking systems in accordance with manufactures' recommendations.

LEARNING OUTCOMES AND CONTENT

5.4.1 Explain the operation and components of electronic braking systems.

- control units
- wiring
- calipers
- solenoids

5.5 Tire Pressure Monitoring

Duration: Total 1 hour Theory 1 hour Practical 0 hours

Cross Reference to Training Standard: OA F16

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to explain the operation and components of tire pressure monitoring systems in accordance with manufactures' recommendations.

LEARNING OUTCOMES AND CONTENT

5.5.1 Explain the operation and components of tire pressure monitoring systems.

- sensors
- control units

AUTOMOTIVE SERVICE TECHINICIAN – LEVEL 3

5.6 Electronic Suspension Systems

Duration: Total 2 hours Theory 2 hours Practical 0 hours

Cross Reference to Training Standard: 5168.01

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to explain the operation and components of tire electronic suspension systems in accordance with manufactures' recommendations.

LEARNING OUTCOMES AND CONTENT

5.6.1 Explain the operation and components of electronic suspension system.

- sensors
- wiring
- control units

5.7 Vehicle Pre-alignment Inspection

Duration: Total 3 hours Theory 1 hour Practical 2 hours

Cross Reference to Training Standard: 5169.01, 02

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to perform pre-alignment inspections in accordance with manufactures recommendations.

LEARNING OUTCOMES AND CONTENT

5.7.1 Perform pre-alignment checks following manufacturers' recommendations.

- tires
- weight distribution / proper loading
- trim height
- bearing condition and adjustment
- suspension system condition
- requirements for tailoring alignment settings
- steering linkage condition

AUTOMOTIVE SERVICE TECHINICIAN – LEVEL 3

5.8 Vehicle Alignment Diagnostics

Duration: Total 6 hours Theory 6 hours Practical 0 hours

Cross Reference to Training Standard: 5168.02

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to identify and explain vehicle handling problems in accordance with manufactures standards.

LEARNING OUTCOMES AND CONTENT

5.8.1 Identify and explain vehicle handling problems.

- vehicle pulls to one side
- vehicle instability
- vehicle wander
- bump steer
- excessive lean on corners
- vibration at cruise or deceleration
- low speed shimmy
- slow steering wheel return
- steering effort
  - heavy
  - light
- excessive steering wheel free-play
- steering stability
- steering kickback
- vehicle roll
- high speed shimmy
- abnormal tire wear
  - front tires
  - rear tires

AUTOMOTIVE SERVICE TECHINICIAN – LEVEL 3

5.9 Vehicle Alignment

Duration: Total 6 hours Theory 0 hours Practical 6 hours

Cross Reference to Training Standard: 5168.03, 04

GENERAL LEARNING OUTCOMES

Upon successful completion the apprentice will have the ability to perform a wheel alignment in accordance with manufactures' recommendations.

LEARNING OUTCOMES AND CONTENT

5.9.1 Perform wheel alignment in accordance with specific vehicle application.

- obtain required specifications
- record alignment readings
- determine required adjustment
- perform required adjustments
- recheck readings
- verify final readings